

# Quality Evaluation of Entrepreneur Education on Graduate Students Based on AHP-fuzzy Comprehensive Evaluation Approach

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**Abstract**— with the development of society, high-level applied students have been an urgent demand and the quality of entrepreneurial education of postgraduate has attracted more and more attention. Based on the requirements of universities society and enterprise for the comprehensive ability of postgraduate, we proposed the evaluation index system and used AHP-fuzzy comprehensive evaluation approach, which organically integrate the quantitative and the objectivity of the analytic hierarchy process(AHP) and the inclusive advantage of fuzzy comprehensive evaluation approach, to evaluate a certain university of its quality of entrepreneur education on graduate students and verified the effectiveness of the approach. This approach can to some extent help government and universities make decisions of how to improve the quality of entrepreneurial education on postgraduate. At the same time, this approach can provide employers a new method of selecting the best staff for enterprises.

**Keywords**— postgraduate, entrepreneurial education, education quality, analytic hierarchy process, fuzzy comprehensive evaluation approach.

## I. INTRODUCTION

Entrepreneurial education had been officially introduced to our country from 1999, and Chinese People's University with other 9 universities had been set as experiment universities by national ministry of education. Our country's entrepreneurial education has been flourishing developing from then on. Entrepreneurial education of undergraduate had been continuous carried out and made much achievement. However, a large gap of high-level applied talents still exists for China's economic development. Therefore, entrepreneurial education among postgraduate has been widely concerned. For a long time, postgraduate's educations were always concentrated on their professional basic knowledge, scientific research ability and lose sight of their practical ability. We had paid more attention on their professional knowledge and usually took their research ability as a standard to make judgment. This training model had obviously can't satisfy society's requirement of applied talents. For the government to make further policy to improve the quality of entrepreneurial education and universities to change the teaching model to satisfy the demand of high-level applied talents of society, therefore, we do research on the evaluation of postgraduate's entrepreneurial education have great significance.

In 1989, United Nations Educational, Scientific and Cultural Organization (UNESCO) hold a conference about "Education Symposium Facing 21 Century" in Beijing China and formally proposed the definition of entrepreneurial education. Entrepreneurial education can be classified as broad sense and narrow sense. Broad sense of entrepreneurial education aims to hold the value of fostering creative students and emphasis practice. We should set some courses to cultivate their pioneering quality. Narrow sense of entrepreneurial education aims to launch some education activities to satisfy their need in the process of entrepreneurship [1]. While based on the broad sense and narrow sense of entrepreneurial education the entrepreneurial education of postgraduate aims to cultivate their entrepreneurial sense, entrepreneurial ability, pioneering spirit and give them guidance of pioneering an enterprise. Through entrepreneurial education we can stimulate entrepreneurial motivation and provide necessary guidance to postgraduate. Tao [2] analyzed the significance of present entrepreneurial education of postgraduate in the paper "Reflection of The Theories and Practice of Entrepreneurial Education" based on Central South University and said that we should focus on pioneering sense, concept of employment, personal basic quality, comprehensive entrepreneurial ability, and the basic theory of entrepreneur. Peter Robinson [3] made a evaluation of most American's entrepreneurial education from 6 aspects include mounts of entrepreneurial courses, the formal academic projects, such as majors, participated human resource, such as teachers and some relevant staffs, and some academic activities about entrepreneurial education and so on. At the same time, he said the key point of evaluating the quality of entrepreneurial education is the comprehensive quality of postgraduate. McMullan & Gillin [4] think that we

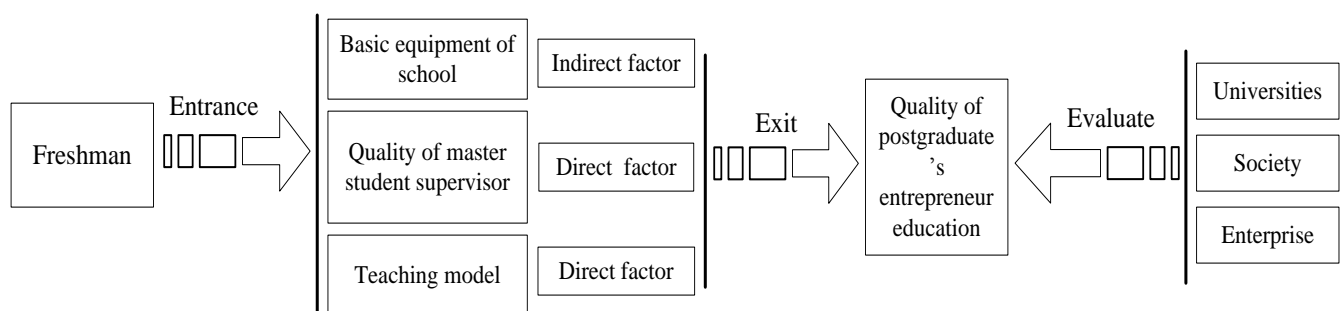
should consider how much contribution the postgraduate did to the society after graduated not only their personal success. Evaluation of entrepreneurial education is focus on the goal of entrepreneurial education about what we have achieved and how much we have finished. To improve the quality of entrepreneurial education and check the effectiveness we must build a scientific and reasonable evaluation mechanism and approach.

Nowadays, the enroll scale of postgraduate with major degree are expanding and cultivation of high-level applied talents are more and more important. Universities respond to government's call to integrate the social education resource and set the goal of entrepreneurial education to create the education conditions, teaching models and evaluation mechanism. At the same time, we are in urgent to build a series of scientific and reasonable evaluation approaches to accurately assess the quality of present entrepreneurial education and propose some concrete suggestions for government and universities to make further progress of entrepreneurial education. In this paper we used AHP-fuzzy comprehensive evaluation approach, which organically integrate the quantitative and the objectivity of the analytic hierarchy process(AHP) and the inclusive advantage of fuzzy comprehensive evaluation approach, to evaluate a certain university of its quality of entrepreneurial education on graduate students and verified the effectiveness of the approach. This approach can to some extent help government and universities make decisions of how to improve the quality of entrepreneurial education on postgraduate. At the same time, this approach can provide employers a new method of selecting the best staff for enterprises.

## II. EVALUATION CRITERIA SYSTEM OF POSTGRADUATE'S ENTREPRENEURIAL EDUCATION

Establishment of the evaluation criteria system is the foundation of postgraduate's quality evaluation. We collected some literature date of building evaluation criteria system and summarized postgraduate's evaluation criteria which [5] are built in three aspects of students' quality, culture condition, teaching management. Wang [6] in the evaluation of postgraduate' quality with major degree used questionnaire investigation, Delphi method and Analytic hierarchy process method to build the evaluation criteria system. In the study of full-time major degree postgraduate's education, by investigation Guo [7] found some problems, proposed some reform suggestion and finally set up a relatively perfect, scientific evaluation criteria system.

By summarizing and analyzing the present literature date, our research begin from how the quality of postgraduate's entrepreneur education form, and set the freshman as the entrance, and considered basic equipment of school which will cause indirect effect of postgraduate's quality, and the quality of master student supervisor which will have direct effect, and the teaching model which will cause restricting factors. At the same time, the graduated postgraduate will receive appraisement from universities, society and enterprise. All the factors above will finally decide the comprehensive quality of postgraduate and we can make an evaluation of entrepreneurial education. The formation mechanism of this process is described in the Figure1. Based on the formation mechanism of postgraduate' comprehensive quality we used investigation, statistical methods Delphi method and so on to build the evaluation criteria system. In this paper, we based on the present study and the general evaluate procedure, and set the quality of postgraduate as the top-level, and the second level are divided into A1: Teaching model of school; A2: Comprehensive quality of postgraduate; A3: Supports of school; A4: Social recognition four aspects, and in the third level we make further thinning of the second level. In this process we investigated some key universities and talked to many graduated postgraduate, experts in the education field, some human resource managers and by our selection and induction and finally we got the evaluation criteria system of postgraduate's entrepreneurial education in the Table1.



**FIGURE1. THE FORMATION MECHANISM OF POSTGRADUATE'S ENTREPRENEURIAL EDUCATION**

**TABLE 1**  
**EVALUATION CRITERIA SYSTEM OF POSTGRADUATE' ENTREPRENEURIAL EDUCATION**

| Target layer  | Criterion layer                            | Sub-criterion layer  |
|---|--|--|
| Evaluation criteria system of postgraduate' entrepreneurial education (A) | Teaching model of school (A1)              | Research ability of tutors (A11)<br>Setting course and teaching mode (A12)<br>Extracurricular concrete practice (A13)          |
|   | Comprehensive quality of postgraduate (A2) | Mounts of published papers (A21)<br>Awarded in the competition (A22)<br>English proficiency (A23)<br>Computer proficiency(A24) |
|   | Supports of school (A3)                    | Condition of school life (A31)<br>Students' quality development (A32)  |
|   | Social recognition four aspects (A4)       | Employment of postgraduate (A41)<br>Social credit of postgraduate (A42)<br>Job competence (A43)                                |

### III. MODEL OF AHP-FUZZY COMPREHENSIVE EVALUATION APPROACH

AHP [8] is a multi-objective decision making approach which combines qualitative analysis with quantitative analysis. This approach first decompose the complicate problem into some elements, and then builds a multi-hierarchical evaluation model and decides the membership relation of different hierarchies, and gets criteria weights of each related index. With the combine of AHP method with fuzzy comprehensive evaluation approach [9], we can avoid people's objective judgments and preference which will impact the objectivity and fairness of the evaluation results. In this paper we propose AHP-fuzzy comprehensive evaluation approach. The fundamental steps of the evaluation approach are as follows:

**Step1.** (Build judgment matrix) We have  $m$  goals (scheme or elements), based on the proposed criteria, we make a pairwise comparison of the goals. In the matrix  $a_{ij}$  ( $j=1,2,\dots,m$ ) is the pairwise comparison of relative importance of criteria  $i$  to criteria  $j$ . We get the pairwise comparison matrix  $A=(a_{ij})_{m \times m}$ :

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1m} \\ a_{21} & a_{22} & \cdots & a_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mm} \end{bmatrix}$$

$$\textcircled{1} a_{ij} > 0 ; \textcircled{2} a_{ij} = \frac{1}{a_{ji}} ; \textcircled{3} a_{ii} = 1.$$

When we make a pairwise comparison, we use 1-9 [10] to scale the importance.

**Step2.** (Calculate criteria weights) Compute the largest eigenvalue of the pairwise matrix we get  $\lambda_{\max}$  and the eigenvector  $W$  and normalize it we can get the single hierarchy structure's eigenvector  $w$ , in this case we need to identify the consistency ratio of a matrix, first the matrix's consistency index ( $CI$ ) is found by:

$$CI = (\lambda_{\max} - n) / (n - 1) \quad (1)$$

The consistency index of a randomly generated reciprocal matrix with reciprocal forces is called the random index ( $RI$ ) and is calculated using the matrix order ( $n$ ). So we get the matrix's consistency ratio ( $CR$ ) by:

$$CR = CI/RI \quad (2)$$

A consistency ratio of 0.1 or less is considered acceptable.

**Step3.** (Build the evaluation matrix  $R$ ) Set  $U = \{u_1, u_2, \dots, u_m\}$  is made up of elements of the evaluation criteria system, and set  $V = \{v_1, v_2, \dots, v_n\}$  contains all the possible results that judgments give. Firstly, we evaluate the single index of set  $U$  and get the value to make up of the judgment matrix  $R$ .

**Step4.** (Build the evaluation model) We have got eigenvector  $w$  and judgment matrix  $R$ , and then we make fuzzy comprehensive evaluation. The evaluation equation is as follow:

$$B = w \circ R \quad (3)$$

**Step5.** (Calculate the evaluation result) Normalize  $B$  we will get  $B'$ , and multiple it with judgment vector  $V$ , we can get the final evaluation result  $G$ :

$$G = B' \circ V^T \quad (4)$$

#### IV. APPLICATION EXAMPLES

Some university of logistics engineering major is an education pilot program to satisfy the great need of special talents in the society. This university take advantage of Ningbo-Zhoushan Port and based on the need of developing harbor logistics, international logistics, information logistics to construct the teaching mode of "Quaternary" and try to improve teaching quality of courses. For three years implement, they have made much remarkable achievement. So we take this university as an example to evaluate its postgraduate's entrepreneurial education. Based on the proposed evaluation criteria system, we use the AHP-fuzzy comprehensive evaluation approach to build the judgment matrix in the Table 2.

**TABLE 2**  
**PAIRWISE COMPARISON MATRIX A**

| A  | A1 | A2  | A3  | A4  |
|----|----|-----|-----|-----|
| A1 | 1  | 1/7 | 1/4 | 1/4 |
| A2 | 7  | 1   | 2   | 5   |
| A3 | 4  | 1/2 | 1   | 3   |
| A4 | 4  | 1/5 | 1/3 | 1   |

Using MATLAB we calculate the largest eigenvalue of the pairwise matrix  $A$  and get  $\lambda_{\max} = 4.1509$ . By normalizing the eigenvector we can get the single hierarchy structure's eigenvector  $w_A = (0.0570, 0.5227, 0.2846, 0.1357)^T$

Calculate the matrix's consistency index  $CI$  we can get:

$$CI = \frac{\lambda_{\max} - n}{n - 1} = 0.0754 \quad (5)$$

Calculate the matrix's consistency ratio  $CR$  we can get:

$$CR = \frac{CI}{RI} = 0.0838 < 0.1 \quad (6)$$

Therefore, the consistency ratio of the matrix is acceptable. We make the conclusion that the criteria weights can objectively reflect the importance of each index. Using the same steps we can get the criteria weights of first grade indexes and the secondary indexes. The results are summarized in the Table 3.

**TABLE 3**  
**CRITERIA WEIGHTS OF HAZARDOUS CHEMICAL STORAGE EVALUATION CRITERIA SYSTEM**

| Criteria Weights of first grade indexes     |               |               |               |               |               |               |              |            |               |               |               |
|---|---------------|---------------|---------------|---------------|---------------|---------------|--------------|------------|---------------|---------------|---------------|
| A1<br>0.0570                                |               |               | A2<br>0.5227  |               |               |               | A3<br>0.2846 |            | A4<br>0.1357  |               |               |
| Criteria Weights of secondary grade indexes |               |               |               |               |               |               |              |            |               |               |               |
| A11<br>0.1407                               | A12<br>0.2583 | A13<br>0.6370 | A21<br>0.6050 | A22<br>0.1508 | A23<br>0.1806 | A24<br>0.0635 | A31<br>0.5   | A32<br>0.5 | A41<br>0.1782 | A42<br>0.7514 | A43<br>0.0704 |

Based on the criteria weights in the table 2, we calculate the criteria weights of third grade indexes to the first grade indexes, and normalized it we can get:

$$w = w_1 \circ w_2 = [0.0080, 0.0147, 0.0363, 0.3162, 0.0788, 0.0944 \quad 0.0332, 0.1423, 0.1423, 0.0242, 0.1020, 0.0096]$$

To build the judgment matrix  $R$ , we make set  $U$  which consist of all the third indexes. We grade the evaluation results as “Lower risk”, “Low risk”, “Average risk”, “High risk”, “Higher risk”. To make the result quantization, we set  $V = [90, 80, 70, 60]$ , when the evaluation result is above 90, we say the entrepreneurial education of this university is “Excellent” or if the evaluation result is between 80 and 90 we say the entrepreneurial education of this university is “Good”. If the evaluation result is between 70 and 80 we say the entrepreneurial education of this university is “General”. We invite some experts in the education field, some human resource managers to make up the evaluate team to build the judgment matrix  $R$ :

$$R = \begin{bmatrix} 0.1537 & 0.0475 & 0.2003 & 0.1439 & 0.0845 \\ 0.0144 & 0.0296 & 0.0509 & 0.1063 & 0.0874 \\ 0.1447 & 0.0525 & 0.0980 & 0.1525 & 0.0507 \\ 0.0283 & 0.1405 & 0.0659 & 0.0258 & 0.0107 \\ 0.1241 & 0.1033 & 0.0117 & 0.1187 & 0.0462 \\ 0.0950 & 0.0927 & 0.0591 & 0.0593 & 0.0328 \\ 0.1028 & 0.1127 & 0.1373 & 0.0720 & 0.1616 \\ 0.0695 & 0.0672 & 0.1933 & 0.0061 & 0.0217 \\ 0.0171 & 0.0335 & 0.0082 & 0.0892 & 0.0024 \\ 0.0515 & 0.0458 & 0.1668 & 0.0590 & 0.0651 \\ 0.1059 & 0.1136 & 0.0454 & 0.1257 & 0.1231 \\ 0.0283 & 0.0914 & 0.2030 & 0.1261 & 0.1567 \end{bmatrix}$$

We have got  $w$  and  $R$ , and then we use equation  $B = w \circ R$  to make fuzzy comprehensive evaluation:

$$B = W \circ R = [0.9929 \quad 0.0957 \quad 0.0771 \quad 0.0628 \quad 0.0384] \quad (7)$$

Normalize  $B$  we will get  $B'$ :

$$B' = [0.7837, 0.0755, 0.0609, 0.0496, 0.0303] \quad (8)$$

Then multiply it with the judgment vector:  $V = [90, 80, 70, 60]$ , we can get the final evaluation result  $G$ :

$$G = B' \circ V^T = 90.50 \quad (9)$$

Therefore, we can make the conclusion that entrepreneurial education of this university is “Excellent”.

## V. CONCLUSION

Based on the great demand of high-level applied talent of society and the background that the enroll scale of postgraduate with major degree are expanding, we made research on the evaluation of postgraduate’s entrepreneurial education. Based on the present teaching mode of postgraduate and the comprehensive quality requirement of universities, society, and enterprise, we build the evaluation criteria system of postgraduate’s entrepreneurial education. We used AHP-fuzzy comprehensive

evaluation approach, which organically integrate the quantitative and the objectivity of the analytic hierarchy process(AHP) and the inclusive advantage of fuzzy comprehensive evaluation approach, to evaluate a certain university of its quality of entrepreneurial education on graduate students and verified the effectiveness of the approach. This approach can to some extent help government and universities make decisions of how to improve the quality of entrepreneurial education on postgraduate. At the same time, this approach can provide the employers a new method of selecting the best staff for enterprises.

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